US Offshore Wind Energy: Future Cost Analyses and Update

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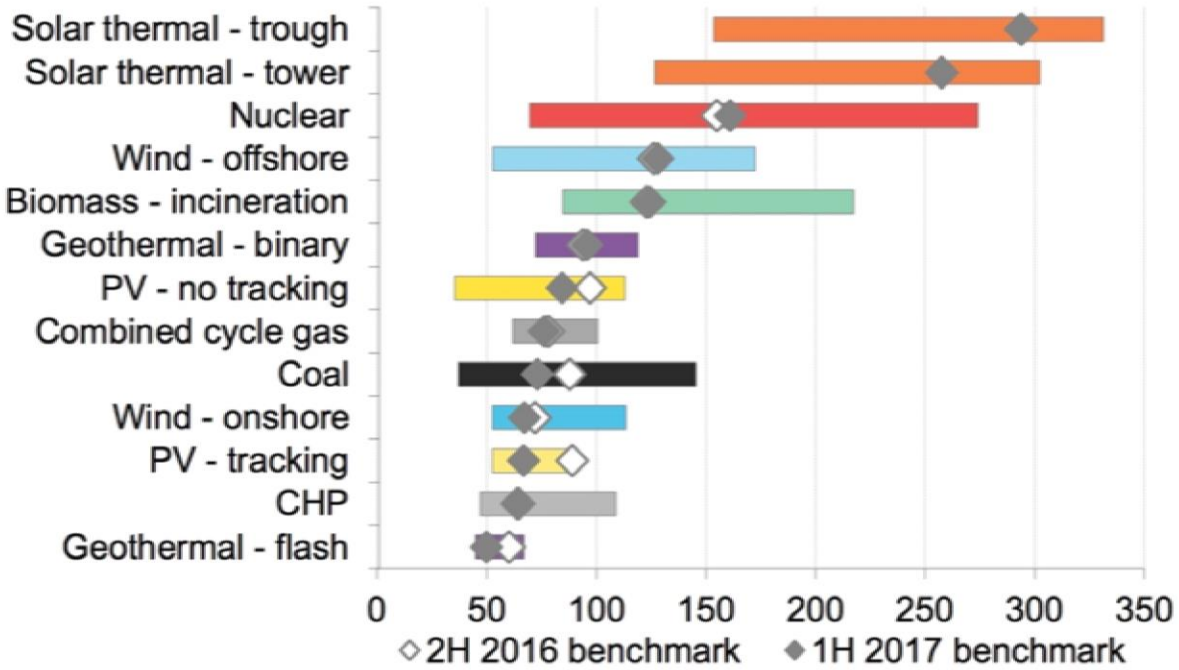
Credit: Stephanie McClellan

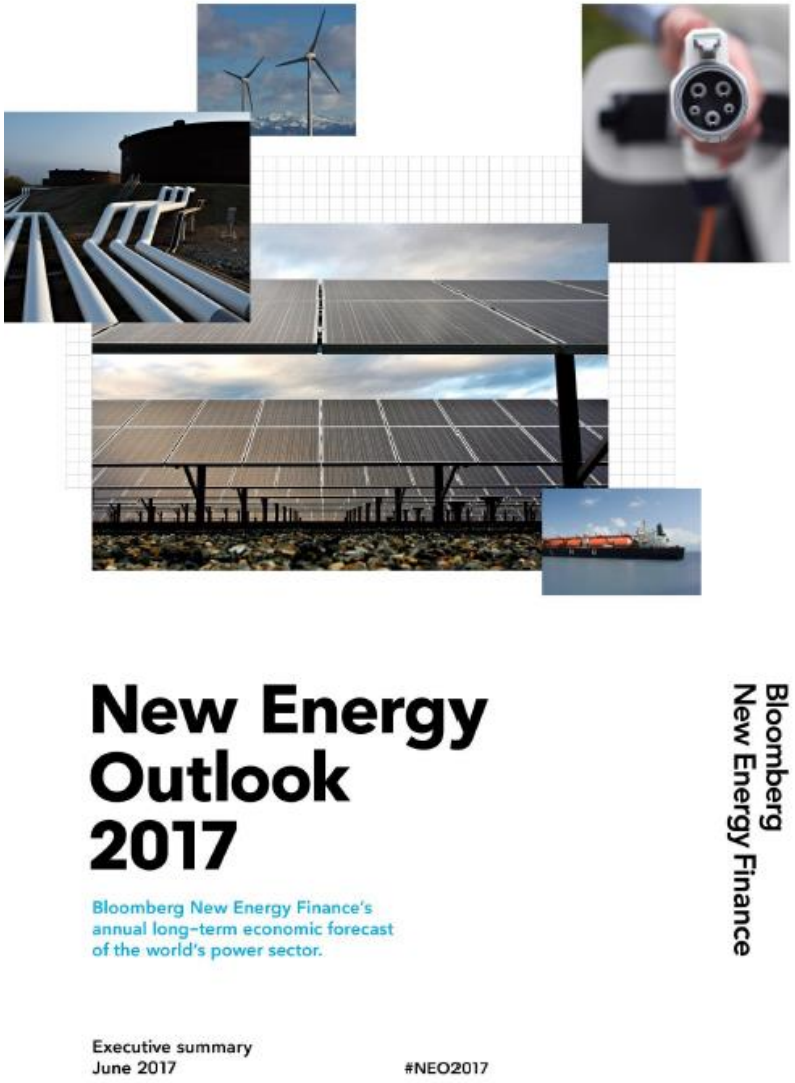
1H 2017 EMEA LCOEs ($/MWh)



Source: Bloomberg New Energy Finance

Bloomberg New Energy Finance

Source: Bloomberg New Energy Finance Offshore Wind Workshop: Market Update, April 2017.

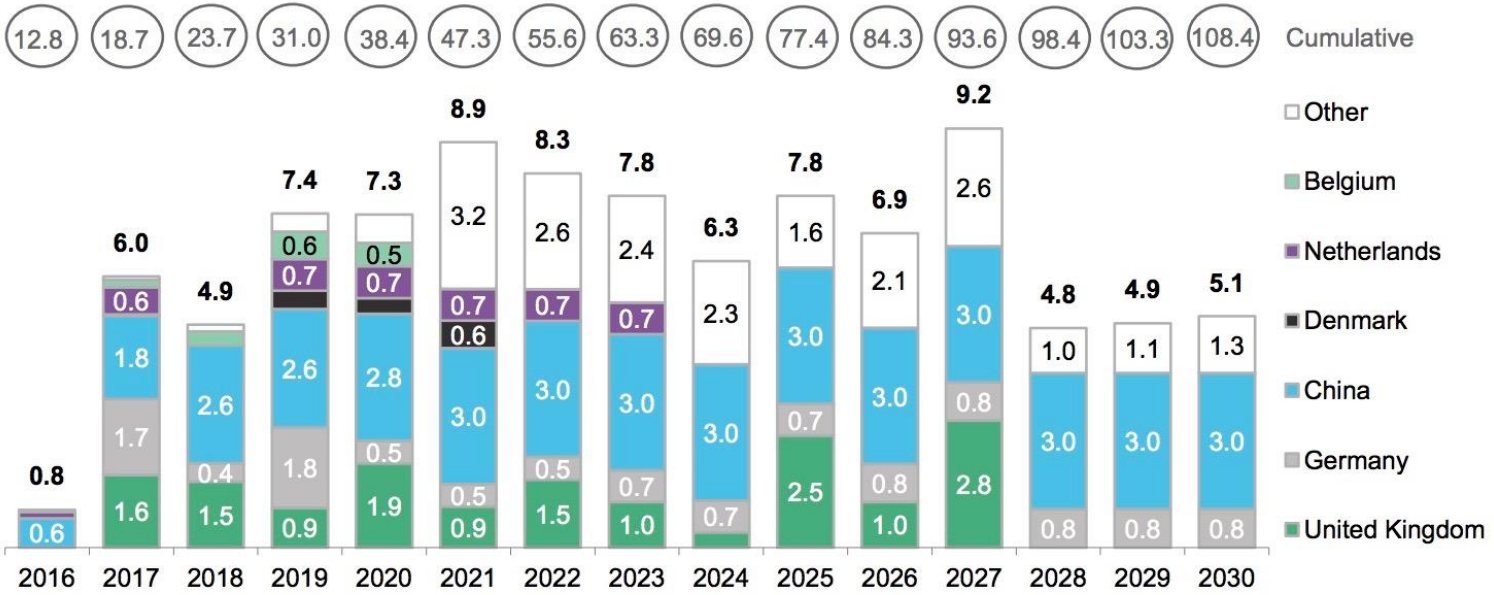


"Onshore wind levelized costs will fall 47% by 2040, thanks to cheaper, more efficient turbines and advanced OPEX regimes. ***In the same period, offshore wind costs will slide a whopping 71%, helped by experience, competition, and economies of scale." (emphasis added)***

Technology	Large wind turbines offshore (year of investment decision)					
	2015	2020	2030	2050	Note	Reference
Average generating capacity per turbine (MW)	4 – 6	6 – 10	10–16	10-20		9 + 11 +14 + 15
Rotor diameter (m)	110 – 155	155 – 180	180 – 200	180 – 250		9 + 11 + 14 + 15
Hub height (m)	80 -100	95 -115	115 -125	115 -155		9 + 14
Annual average plant capacity factor (%)	46-48	48-50	50-52	51-53	A	9 + 15 + 16
Availability (%)	96	97	97	98		9 + 15
Technical lifetime(years)	25	25	25	30		9
Construction time(years)	2 - 4	2 - 4	2 - 4	2 - 4	B	9 + 15
Financial data						
Specific investment, total costs (M€/MW) at 20m depth and 30km from shore ex. grid connection to shore	3.0	2.5	2.1	1.8		6 + 10
Grid connection to shore (M€/MW)	0.36	0.35	0.33	0.32	C	8 + 11
O&M (€/MWh)	19	17	16	15		9

Source: *Technology Data for Energy Plants: Generation of Electricity and District Heating, Energy Storage and Energy Carrier Generation and Conversion*. Danish Energy Agency and Energinet.dk, January 2014.

Global offshore wind forecast (GW)

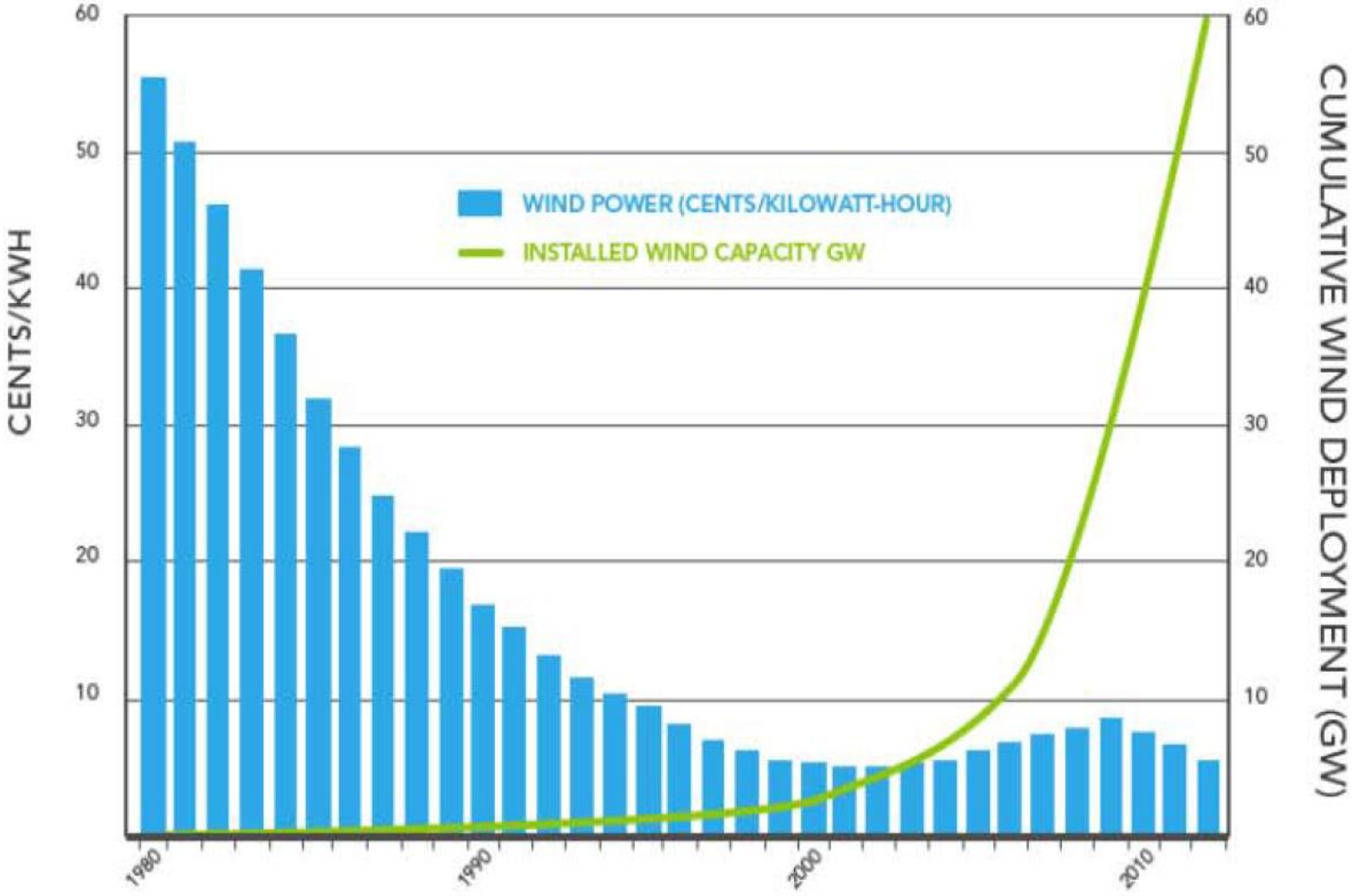


Source: Bloomberg New Energy Finance. Note: "Other" includes France, Ireland, Italy, Japan, Korea, Poland, Sweden, Taiwan and US

Bloomberg New Energy Finance

Source: Bloomberg New Energy Finance Offshore Wind Workshop: Market Update, April 2017.

Deployment and Cost for U.S. Land-Based Wind 2008-2012



Source: U.S. Department of Energy

Offshore wind energy costs:

SIOW projections for New York and Massachusetts

New York Offshore Wind Cost Reduction Study

- Published March, 2015 with New York State Energy Research and Development Authority (NYSERDA)
- Consultants to SIOW
  - UK Crown Estate's cost reduction team
  - Leading energy finance firm handling European offshore wind financing transactions
- Expert panel reviewers
  - US Department of Energy
  - National Renewable Energy Lab
- Advisory board
  - Carbon Trust
  - Statoil
  - German Offshore Energy Foundation
  - UK Offshore Wind Programme Board
  - American Wind Energy Association

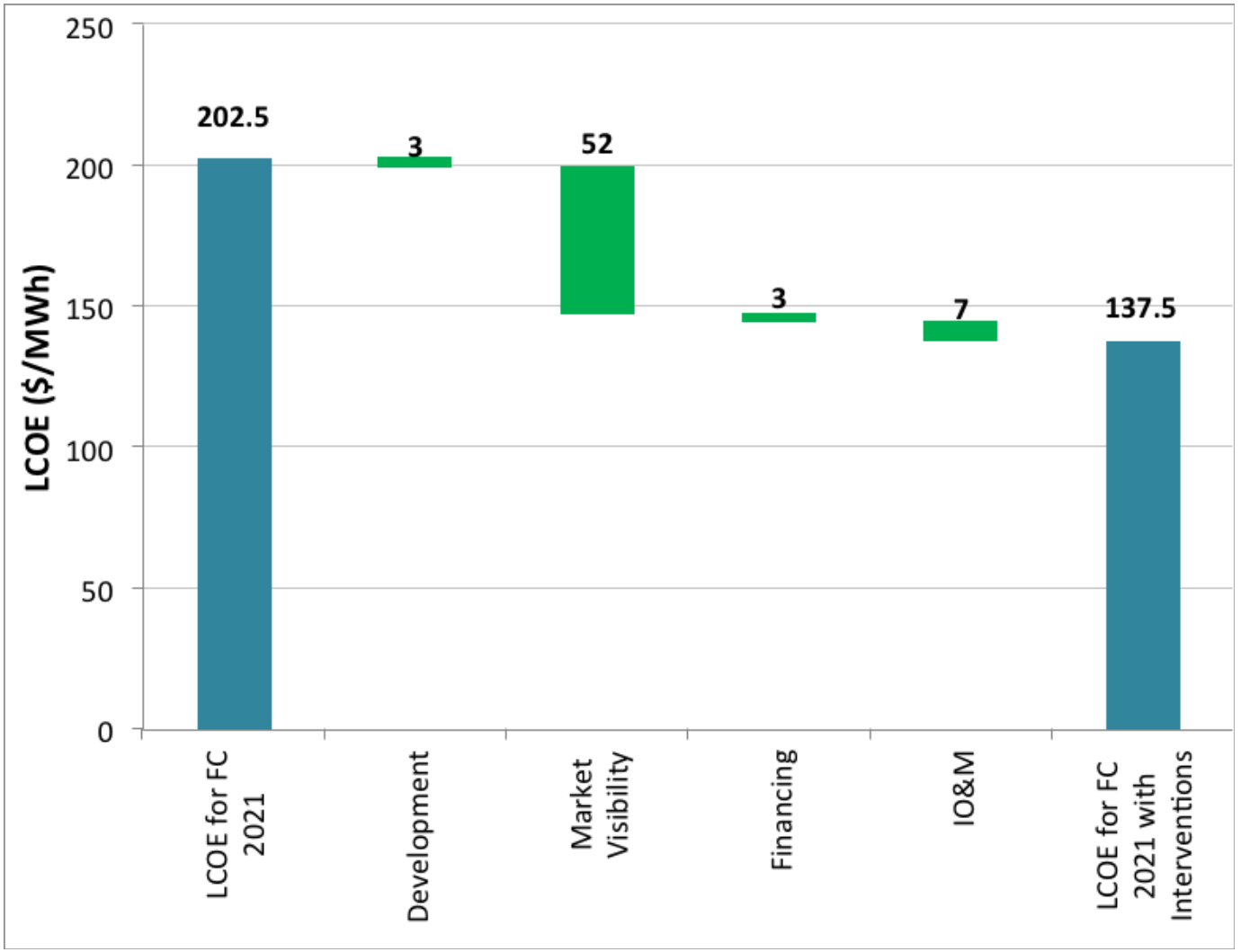
Massachusetts Future Offshore Wind Cost Study

- Presented March, 2016 to Massachusetts legislative leadership and executive agencies
- Obtained CAPEX, OPEX, DEVEX and cost of capital from DONG Energy, OffshorewindMW, Deepwater Wind, and Siemens
- Peer reviewed by:
  - Lawrence Berkeley National Laboratory
  - The Crown Estate
  - Tufts University
  - University of Massachusetts – Amherst
  - National Renewable Energy Laboratory

New York Offshore Wind Cost Reduction Study

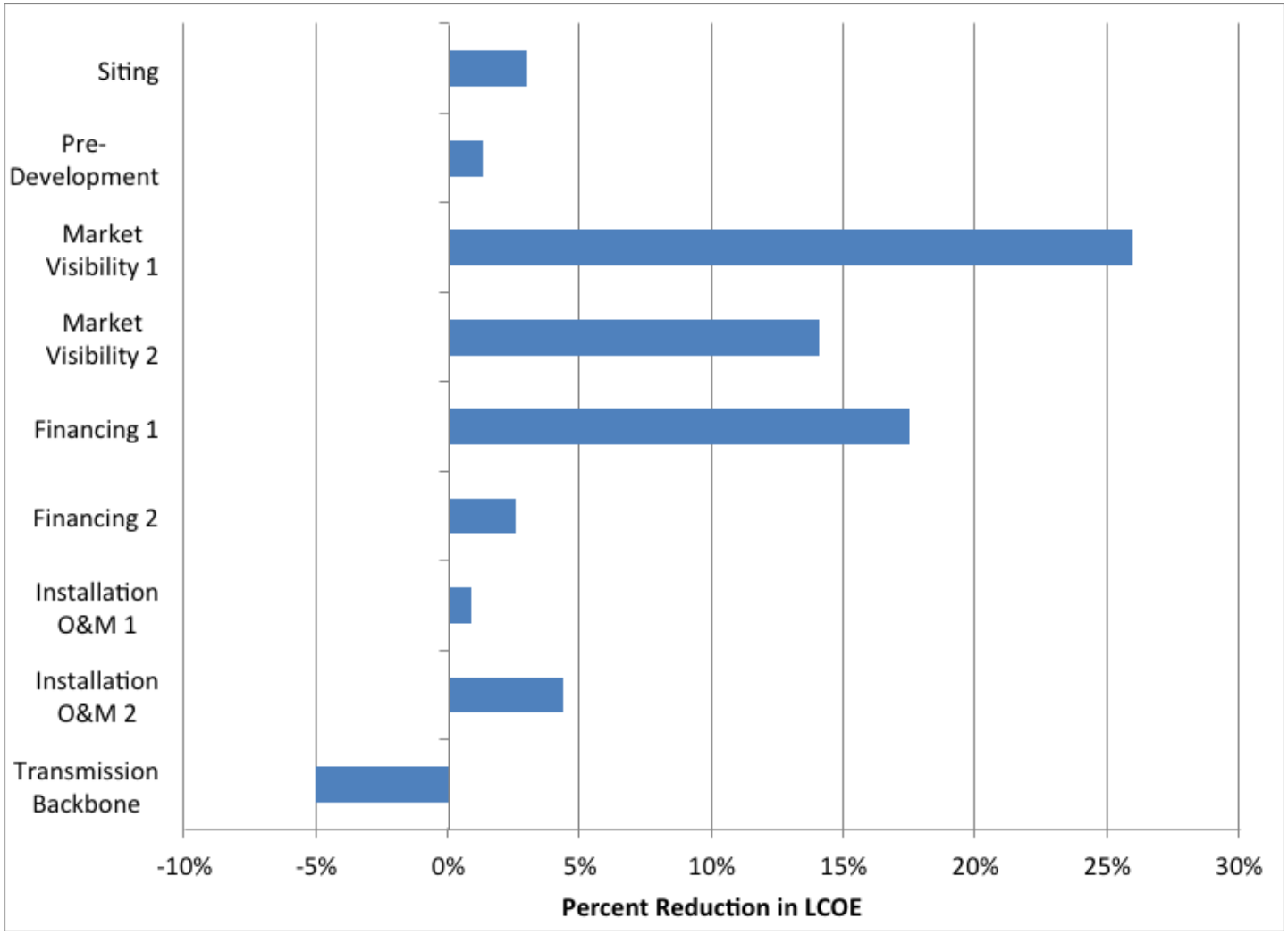
Examined the impacts on LCOE for projects off Long Island of:

1) global offshore wind technology improvements; and 2) state policy and actions.



*LCOE for FC 2021 includes global cost reduction achievable by 2021, U.S. learning from previously installed capacity, cost of equity assumptions that reflect today's U.S. financing environment, and siting at 9nm. Source: New York Offshore Wind Cost Reduction Study, p. 63.

New York Offshore Wind Cost Reduction Study



Source: New York Offshore Wind Cost Reduction Study, p. 59.

Harnessing the Power of Possibility

New York's Clean Energy Standard mandates that 50% of the State's electricity come from renewable resources by 2030. To help the State get there, Governor Andrew M. Cuomo set an unprecedented commitment to responsibly develop 2,400 megawatts of offshore wind—enough to power up to 1.2 million homes.

1.2 NEW YORK STATE OFFSHORE WIND MASTER PLAN

The objectives of the State's Master Plan are to (1) identify areas for BOEM to consider for future offshore wind development off New York's Atlantic Coast, (2) recommend measures that could be implemented with future offshore projects to mitigate potential impacts, and (3) offer ways to purchase offshore wind energy to ensure the lowest costs to ratepayers. The Master Plan will be issued by the end of 2017.

The Master Plan is a joint effort of the New York State Energy Research and Development Authority (NYSERDA), the New York State Department of Environmental Conservation, the Department of Labor, the Department of State, the Department of Public Service, Empire State Development, the Long Island Power Authority, the New York Power Authority, and the Office of Parks, Recreation and Historic Preservation. In support of its Master Plan, the State conducted over 20 studies that assessed a 16,740-square-mile area of the ocean and adjacent areas, from the south shore of Long Island and New York City to the continental shelf break (the "offshore study area (OSA)"). The goal of these studies was to obtain information related to a variety of environmental, social, economic, regulatory, and infrastructure-related issues implicated in planning for future offshore wind energy development. Figure 1 shows a map of this area[1], and Table 1 provides a list of the studies conducted and their general categorization. Further discussion of the studies contributing to the identified Area for Consideration is provided in Section 2.

Massachusetts Offshore Wind Future Cost Study

LCOE projections for a future build out of 2,000MW of offshore wind over three tranches, off Massachusetts's coast.

	Tranche A FC 2020	Tranche B FC 2023	Tranche C FC 2027
LCOE without transmission (2016 ¢/kWh)	12.4¢	9.8¢	7.9¢
LCOE with transmission (2016 ¢/kWh)	16.2¢	12.8¢	10.8¢

Source: Massachusetts Offshore Wind Future Cost Study, p. 31.

Impact of scale

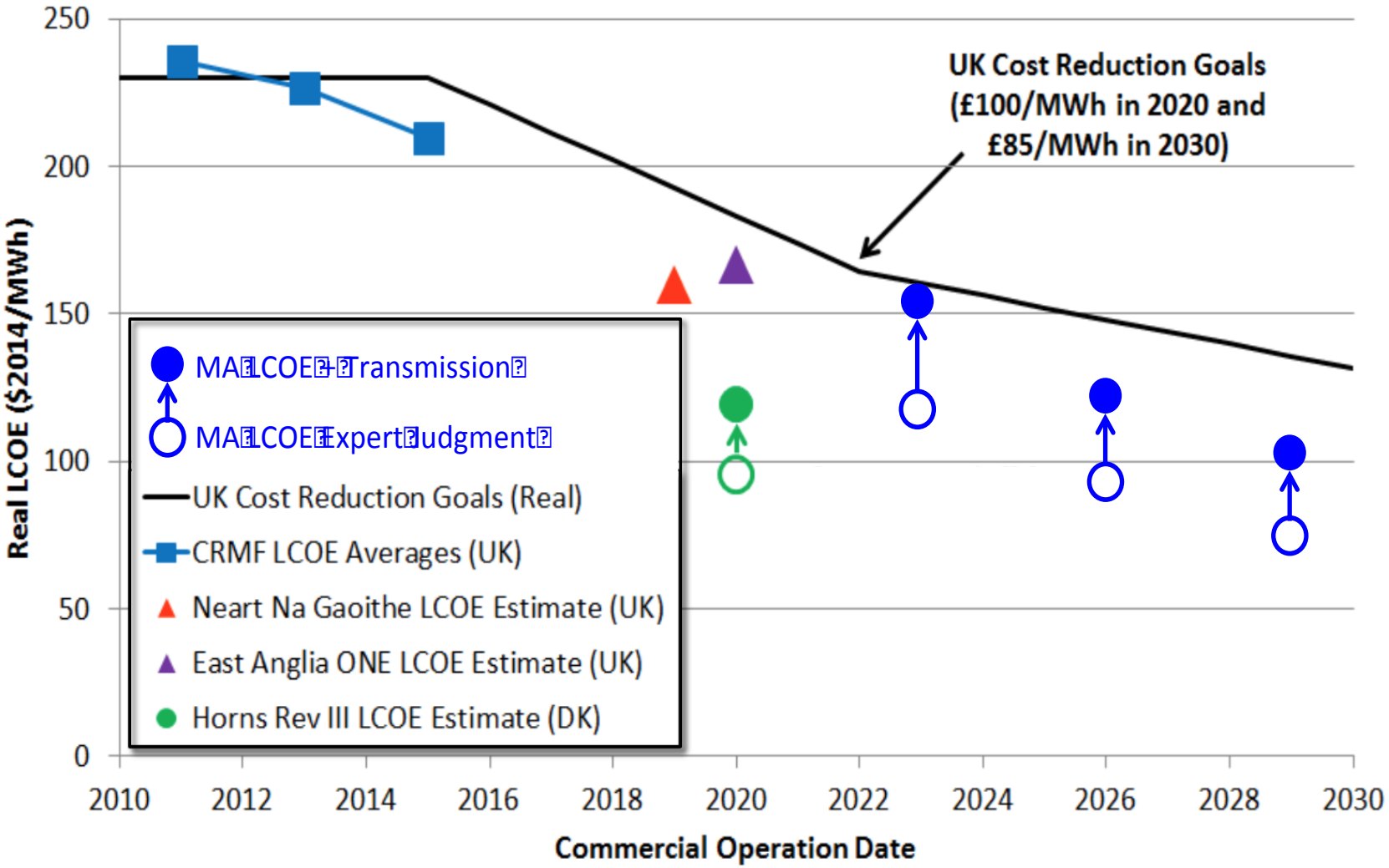
Project	Anticipated Financial close (year)	Project size (MW)	OSW Market Visibility in New England (MW)	LCOE (¢/kWh)
MA project proposed	2014[a]	468	400	24¢[b]
RI project under construction	2015	30	30	30¢[c]
Tranche A (this study)	2020	400	2,000	16.2¢
Tranche B (this study)	2023	800	2,000	12.8 ¢
Tranche C (this study)	2027	800	2,000	10.8¢

[a] Proposed Cape Wind project has not yet reached financial close.

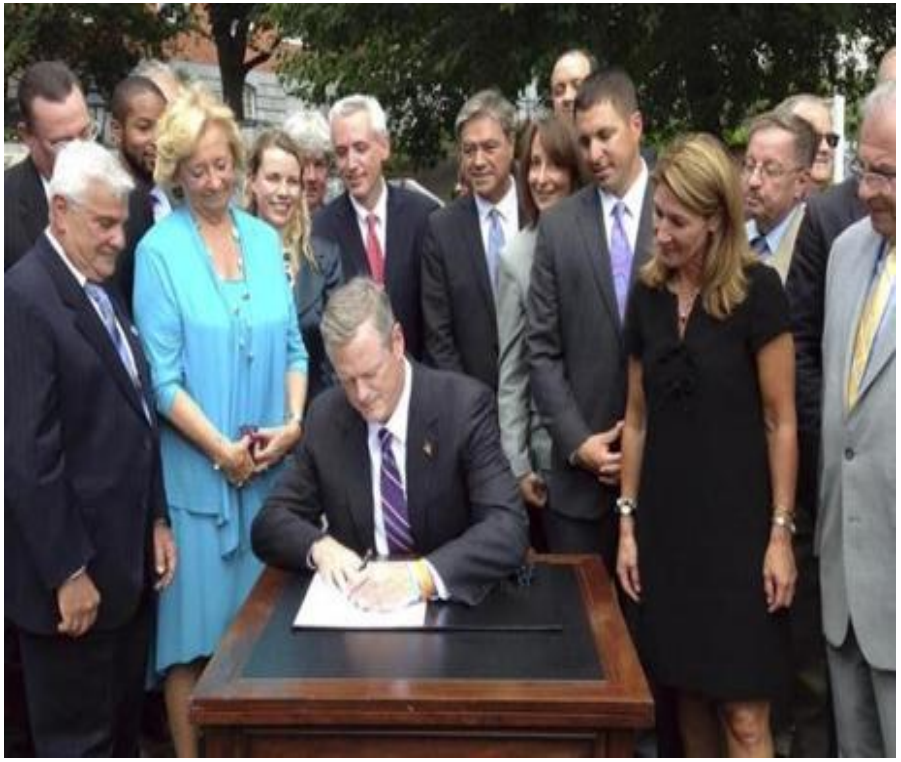
[b] Calculated from published National Grid PPA terms reported in Musial and Ram, converted to LCOE.

[c] Calculated from published PPA terms reported in Musial and Ram, converted to LCOE.

Source: Massachusetts Offshore Wind Future Cost Study, p. 32.



Source: Massachusetts Offshore Wind Future Cost Study, p. 34.



“With our partners in the Legislature, the Commonwealth has taken another major step towards providing residents and businesses with a cost-effective and reliable clean energy future.”

~ Governor Charlie Baker, August 8, 2016

Massachusetts utilities release first offshore wind RFP under new state energy law

Updated on July 3, 2017 at 8:07 AM, Posted on July 3, 2017 at 8:00 AM

Massachusetts utilities on June 29, 2017 released their first solicitation for offshore wind power. (Mary Serreze photo)

For more information

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Credit: Stephanie McClellan